Unit 2

1. Calculate the interplanar spacing for (2 3 1) plane of an fcc structure whose atomic radius is 0.175 nm.
2. A plane cuts intercepts 2a, 3b and c along the crystallographic axes in a crystal. Determine the Miller indices of plane.
3. Calculate the spacing between (1 0 0) and (1 1 1) planes of a cubic system of lattice parameter a.
4. Deduce the Miller indices of a set of parallel planes which make intercepts in the ratio of a: 2b on the x and y axis and are parallel to z-axis. Also calculate the interplanar distance d of the plane taking the lattice to be cubic with a = b = c = 5Å.
5. Determine the Miller indices of plane parallel to the z axis and cut intercepts of 2 and 2/3 along x and y axes, respectively.
6. Determine the number of atoms per unit cell of lead which has an fcc structure. Atomic weight of Pb = 207.2, density of Pb = 11.36 x 10 kg m^{-3} , and a = 3.2 Å.
7. Calculate the lattice constant 'a' of a substance having fcc lattice, molecular weight 60.2 and density 6250 kg/m^{-3}.
8. A crystal lattice has a BCC structure with a lattice constant of 2 Å. Estimate the volume of the unit cell in cubic nanometers.
9. Determine the Miller indices for a plane that cuts the x, y, and z axes at 2a, infinity, 1c respectively.
10. Calculate interplanar spacing between (220) planes in a BCC crystal with lattice parameter 5.5 Å.
11. In a cubic crystal, a lattice plane makes intercepts at a length 2a on x-axis, parallel to y-axis and z-axis. Find the Miller indices of the plane. Draw the Miller plane.
12. Draw (110), (100), (010), (101) plane.
13. A superconductor has a critical temperature 5.5 K. At 0K, the critical magnetic field is 0.0503 Tesla. Find the magnetic field at temperature 2K?
14. A monochromatic beam of X-rays of wavelength 1.24 Å is reflected by face-centered cubic crystal of KCl. Determine the interplanar distances for (1 1 1) planes. Given density of KCl is 1980 kg/m^3 and molecular weight is 74.5.
15. Calculate Miller indices of a plane making intercepts at 2, 3 and 4 on the coordinate axis of an orthorhombic crystal with a:b:c=1:2:3.
16. A monochromatic beam of X-rays of wavelength 3.23 Å is reflected by face-centered cubic crystal of KCl. Determine the interplanar distances for (1 1 1) planes. Given density of KCl is 1980 kg/m^3 and molecular weight is 74.5.
17. The critical field of a superconductor at 0 K is 0.080 T, and its critical temperature is 5.3 K. Find the critical field at T=3 K?

18. Critical temperature of a superconductor when no magnetic field present is Tc. Find the temperature at which critical field becomes half of its value at 0K.

Unit 3

1. A laser emits light of wavelength 500 nm**.** Find the energy of one photon.

2. Find the frequency of laser light having wavelength 532 nm.

3. A step-index optical fiber has core refractive index 1.48 and cladding refractive index 1.46.
   Calculate:
   (a) Numerical aperture
   (b) Acceptance angle in air

4. The core diameter of a fiber is 50 μm and its numerical aperture is 0.22. If the operating wavelength is 850 nm, calculate the V-number and the number of guided modes.

5. An optical fiber has NA = 0.30. Determine the maximum angle at which light can enter the fiber from air.

6. For a fiber, core refractive index = 1.50 and cladding refractive index = 1.495. Find the relative refractive index difference.

7. A fiber operates at wavelength 1.55 μm with NA = 0.11. Determine the maximum core radius for single-mode operation.

8. An optical signal of input power 2 mW is transmitted through 8 km of fiber. If the output power is 0.5 mW, calculate the attenuation in dB/km.

9. Calculate the critical angle at the core–cladding interface for a fiber having core refractive index 1.49 and cladding refractive index 1.47.

10. The refractive index of the core is 1.52. If the relative refractive index difference is 0.01, calculate the refractive index of the cladding.

11. A step-index fiber has core radius 5 μm and numerical aperture 0.20.

If operating wavelength is 1.3 μm, calculate:

(a) V-number

(b) Number of guided modes

12. For a fiber operating at 1.55 μm, the core radius is 4 μm and NA = 0.12. Find the V-number. State whether it is single-mode.

13. A step-index fiber supports 500 modes at wavelength 1 μm. Calculate the V-number.

14. Find the maximum core radius for a fiber with NA = 0.15 to operate in single mode at wavelength 1.3 μm.

15. A multimode fiber has V-number 80 at wavelength 850 nm. Estimate the number of guided modes supported.